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Effects of Crew-Aiding Behaviors on Soldier Performance During Target Engagement Tasks in a Virtual Battlefield Simulation

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Agenda

- Introduction
- Overview
- Method
- Results
- Discussion
- Conclusion
- Questions

Introduction

- U.S. Army network-centric, digital battlefields continue to expand
- Greater amounts of incoming information and increased resource demands
  - Maintain local SA
  - Providing information and receiving orders
  - Platform mobility
  - Route planning and control of unmanned assets
  - Sensor monitoring
  - Seek out, close with, and destroy enemy forces

Overview

- Increase in Soldier workload
  - Performance degradation (e.g., accuracy, latency)
  - Errors
- Decrease in time available to complete tasks

Overview

- Research focused on key aspect of "Seek out, close with, and destroy enemy forces"
  - Target prioritization
  - Weapon selection
  - Munition matching (weapon type and target)
  - Target engagement
- Decision aids (Crew Aiding Behaviors) for target prioritization, weapon and munition selection, and target engagement

Overview

- Effects on workload and task time (stress and SA ancillary)
- Controlled experiment conducted to determine effects of CABs
  - Degree of effect unknown
  - Not all automation "enhancements" have been shown to reduce Soldier burdens
    - FBCB2 spot reports

Method

- Twelve active duty male Soldiers
  - Senior NCOs and one Officer
  - Primarily Armor MOS
- Task training in both conditions
- Counterbalanced order by conditions
- Mixed-model ANOVA
  - Within Subjects:
    - Baseline, CAB, NoCAB
  - Between Subjects: Treatment order
    - CAB 1st vs. NoCAB 1st

Method

- Objective performance measures
  - Stress via Galvanic Skin Response (GSR)
  - Task time
- Subjective performance measures
  - Stress survey (physical and mental)
  - NASA-TLX
  - China Lake SA

Method

- GSR armband

Method

- NoCAB

  Presented randomized list of targets
  - Prioritize based on proximity and threat
  - Select appropriate weapon system
  - Select appropriate munition
  - Engage and destroy target
  - Move to next target
  - Repeat until all targets destroyed or munitions expended

Method

- CAB

  Presented list of targets sorted and prioritized automatically

  - Verify and select each target in queue
  - Verify recommended weapon
  - Verify recommended munition
  - Engage and destroy target
  - Move to next target
  - Repeat until all targets destroyed or munitions expended

Method

- Baseline
  - GSR taken during duty hours not related to experiment
  - Survey ratings of typical drive from residence to base

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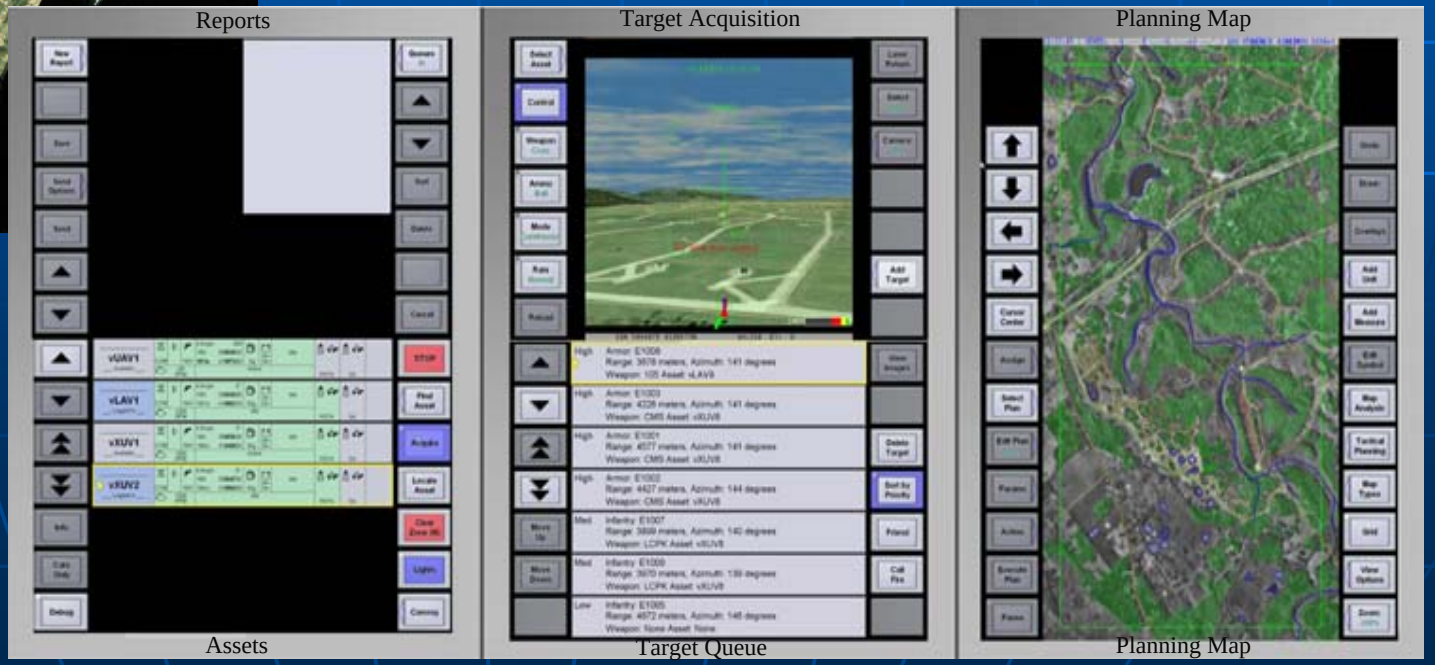
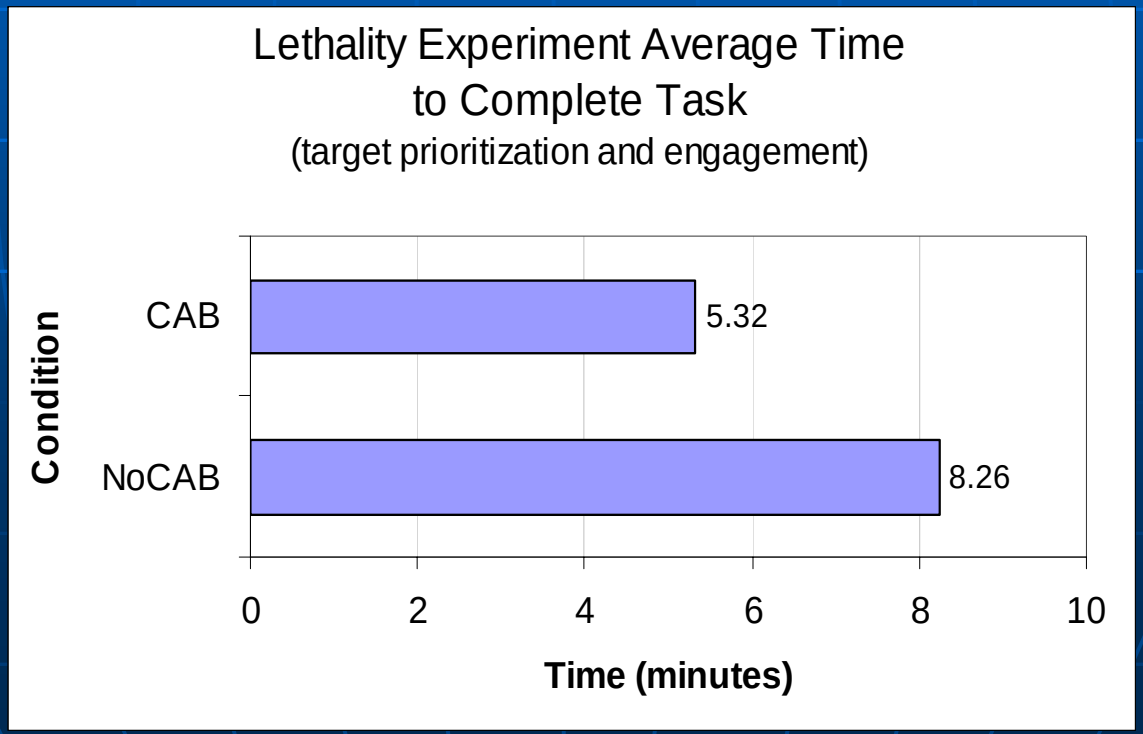
Method

Soldier-in-the-loop (SIL) simulator



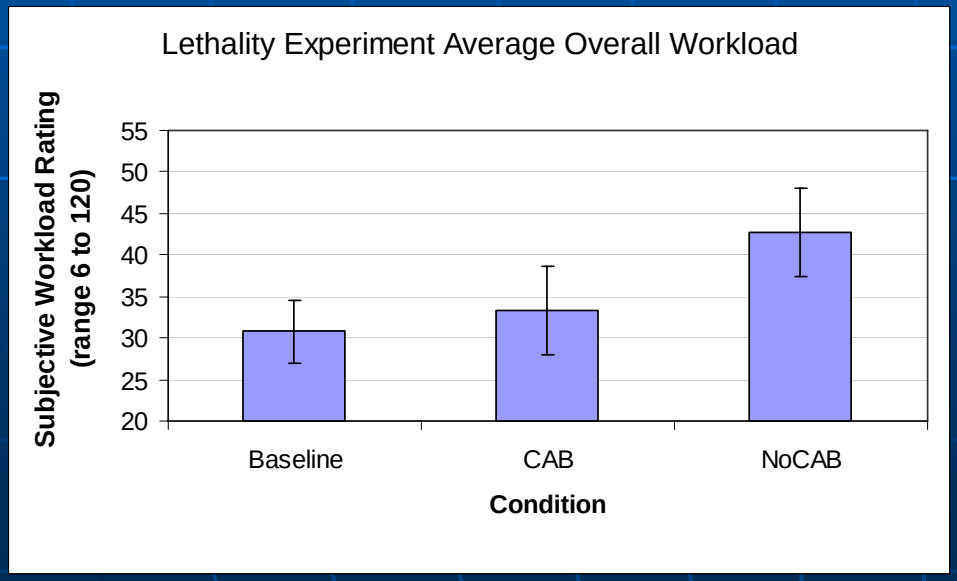
Results

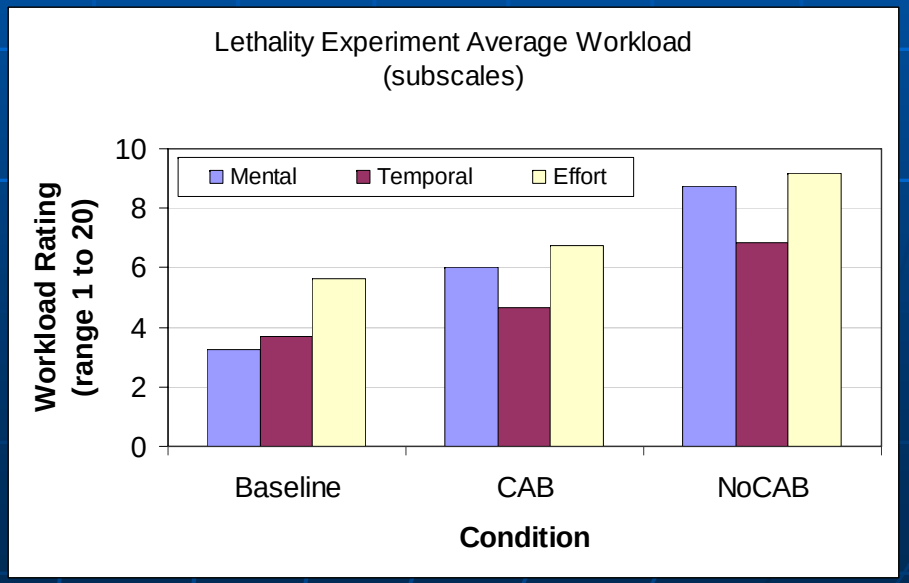
- Significant reduction in task time
  - 36% (2 min 56 sec.) faster using CABs



Results

- Significant reduction in workload
  - Overall workload reduced by 28%
  - Mental and Temporal 46%, Effort 36%





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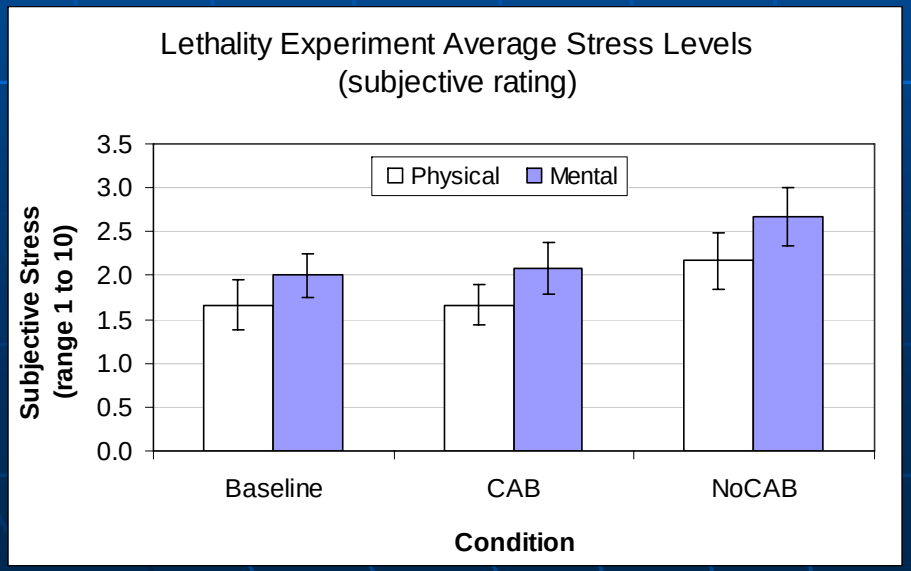
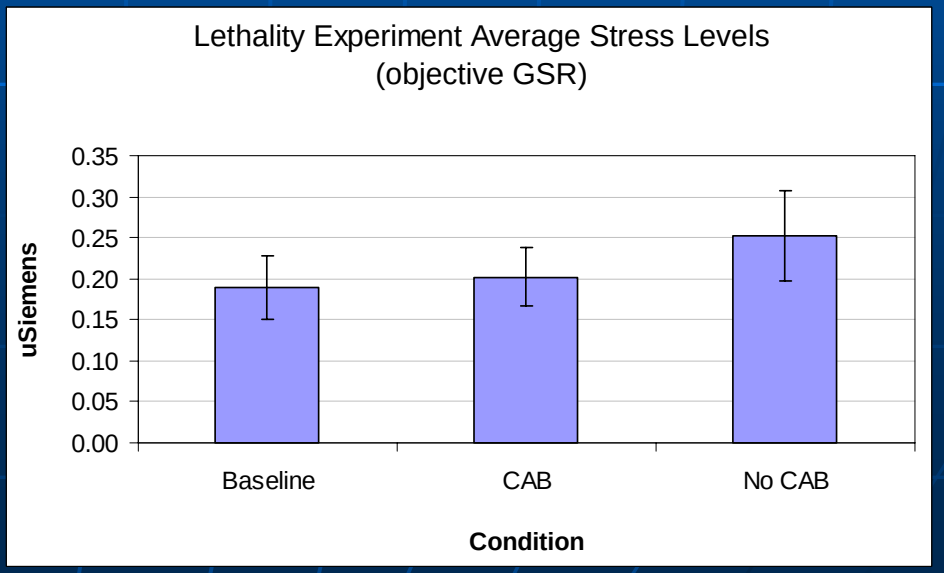
Results

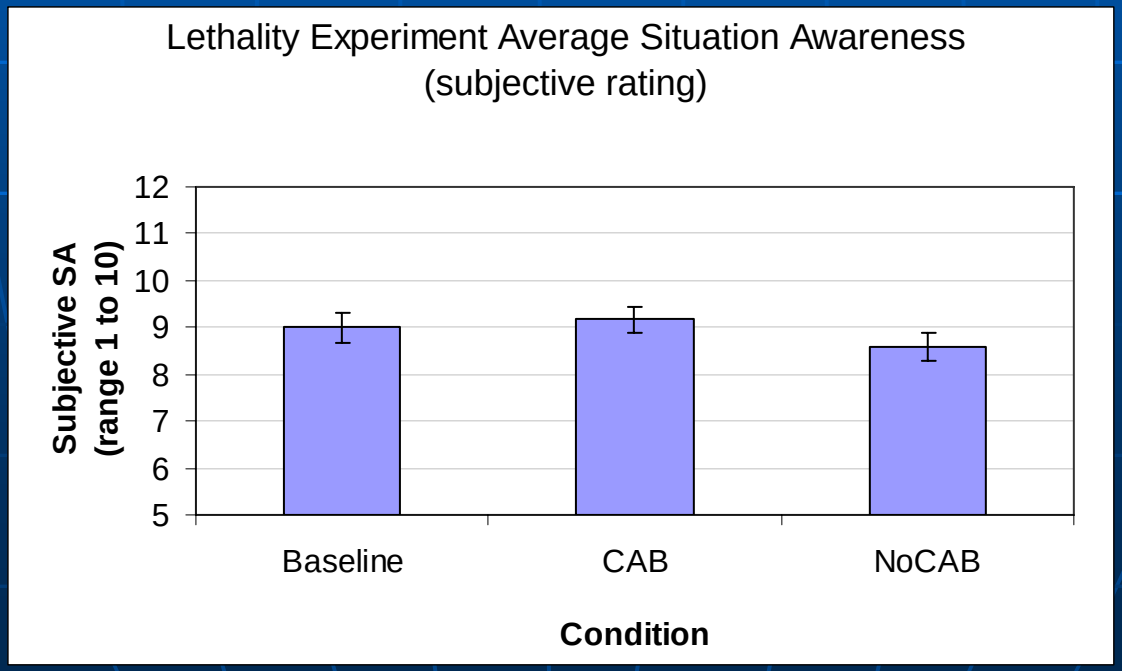
- Reduction in stress
  - Not statistically significant at α=.05
    - Survey p=.051; GSR p=.059
  - Trend of lower stress in CAB condition for both survey and GSR stress





Results

- Increase in SA
  - Not statistically significant at α=.05 (p=.063)
  - Trend of increased SA in CAB condition



Conclusion

- Summary
  - Significant reduction in task time
    - 36% faster using CABs
  - Significant reduction in Soldier workload
    - Overall workload reduced by 28%
    - Mental and Temporal 46%, Effort 36%
  - Reduction in Soldier stress and Increase in SA
    - Though not statistically significant, trends favored CABs
    - Trend of lower stress (survey and GSR) when using CABs
    - Trend of increased SA when using CABs

Conclusion

- Implications
  - Decision aids can make positive contributions to Soldier performance
  - Soldiers may be able to better attend to increasing 'digital battlefield' demands
  - CABs offer robust configuration and maintain a human-in-the-loop for critical tasks (e.g., decision to fire)
  - Potential for incorporation into Future Combat Systems (FCS)

Questions

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